GOLF CLUB WITH IMPROVED STRUCTURAL INTEGRITY

This application claims the benefit under 35 U.S.C. § 119(e) of U.S. Provisional Application No. 60/420,386 filed on October 22, 2002, for GOLF CLUB WITH IMPROVED STRUCTURAL INTEGRITY, which is incorporated by reference.

BACKGROUND OF THE INVENTION

The present invention relates generally to a golf club. In particular, the present invention relates to the club head of a driver.

In golf, the driver hits the ball farther than every other club, and it is considered the most important club next to the putter. A chief problem is that most golfers lack distance off the tee robbing the golfers of the opportunity of getting close enough to hit approach shots with high percentage short irons. They, instead, must use hard-to-hit long irons or even fairway woods to reach the green. To make matters worse, trouble off the tee from traps, obstructions, out-of-bounds, and deep rough greatly increases scores. As the world's greatest player, Tiger Woods, is fond of saying, "A good drive makes all things possible."

Over the past two decades no club has evolved more than the driver. In the 1970s, for example, drivers were constructed of laminated wood or persimmon. Head size was about 150cc. In recent years, however, drivers have been made almost entirely out of titanium and similar exotic metals initially developed for space exploration and the aircraft industry. This trend began in 1979 when Gary Adams with Taylor Made Golf marketed the first metal wood.

When the first generation of titanium drivers reached the hands of golfers, the impact was immediate and significant. The forerunner was the Big Bertha, marketed by Callaway, and it enhanced player performance mainly through providing a larger club face, which is more forgiving on off-center hits.

Titanium is a metallic element whose unique properties include high strength, low density, excellent fatigue and corrosion resistance, and low modulus. Titanium is also well known for its high strength-to-weight ratio. In addition, these properties provide a notably “springy” quality to titanium. Indeed, aircraft springs were one of the first uses of titanium alloys. Because of its spring-like effect, the material yields excellent energy transfer with exceptional efficiencies. Titanium

also permits the use of thinner walled equipment. Combined, these characteristics make titanium an ideal material for golf club design and construction.

Current technology limits driver head volume to the 350-400cc threshold. Beyond this point, the thinner walls required to increase volume start to fail, particularly at seams and walls. One might be tempted to simply increase wall thickness and boost overall head weight to elevate club head failure. Unfortunately, uniform weight - approximately 200g - is necessary to maintain uniform swing weight (how heavy the club feels).

The main goal of increasing club head size is increasing forgiveness and boosting energy transfer. This takes titanium technology to its highest possible level. The first step is developing a titanium alloy ideally suited to "super size" driver designs and concepts. Titanium can exist in two crystal forms or phases. The first, alpha, has a hexagonal close-packed crystal structure, while the second, beta, has a body-centered cubic structure. In unalloyed titanium, the alpha phase is stable at all temperatures up to 1620°F, at which point it transfers to the beta phase. This temperature is known as the beta transus temperature. The beta phase is stable from 1620°F to the melting point. As alloyed elements are added to pure titanium, the temperature at which the phase transformation occurs and the amount of each phase present changes. Alloy additions to titanium, with the exception of tin and zirconium, tend to stabilize either the alpha or the beta phase. Alpha stabilizers stabilize the alpha phase at higher temperatures, and beta stabilizers stabilize the beta phase at lower temperatures.

Present technology indicates that the beta crystal form possesses the highest potential for the super size driver category of club heads, both in terms of shell and face construction. The larger shell is necessary to "back" the extra large face, which provides an extra large "trampoline" to deliver long drives even from off-center hits. However, the shape and contour of the titanium shell can affect

performance as much as the material itself. Curved metals, properly treated and designed, tend to be more stable than flat metals.

BRIEF SUMMARY OF THE INVENTION

The present invention is a golf club head for a driver, and a method of making the golf club head. The golf club head has face, rear, toe, heel, top, and bottom portions and a slot that extends from the toe portion, along the rear portion, to the heel portion. Forging the slot on a mold improves the club head structural integrity.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of the golf club of the present invention.

Figure 2 is a top view of the golf club head of the present invention.

Figure 3 is a side view of the back side of the golf club head of the present invention.

Figure 4 is a cross section of the golf club head of the present invention.

Figure 5 is a back view showing a first weighted embodiment of the present invention.

Figure 6 is a back view showing a second weighted embodiment of the present invention.

Figure 7 is a back view showing a third weighted embodiment of the present invention.

DETAILED DESCRIPTION

Figure 1 shows golf club driver 10 with shaft 12, grip 13 and club head 14.

Figures 1 and 2 show the golf club head of the present invention, which is a driver having an improved club head. Driver 10 includes shaft 12, grip 13, and club head 14 with face 16 and crown 18. Crown 18 further includes rear portion 20, toe portion 22, heel portion 24, and top portion 26. Shaft 12 is connected to club head 14 at rear portion 22 and top portion 24.

Figure 3 shows the side view of the golf club head of the present invention. Golf club 10 includes shaft 12 and club head 14. Club head 14 includes crown 18 with rear portion 20, toe portion 22, heel portion 24, top portion 26 and slot 28, and sole 30. Slot 28 begins at toe portion 22 and extends along rear portion 20 to heel portion 24.

Slot 28 is about 175 millimeters (mm) long. The depth varies gradually from about 1.5 mm to about 0.3 mm, and the width of slot 28 varies gradually from about 15 mm to about 7.5 mm. Slot 28 is deeper and wider toward toe portion 22 and shallower and narrower toward heel portion 24. This heel-toe-weighted shape allows weight to be moved where it can optimally stabilize club head 14, particularly on off-center hits. In addition, the varying depth provides a "draw bias" that helps correct a player's slice.

To form slot 28, a mold is formed of the negative of crown 18 with slot 28. Preferably, β-14 titanium alloy is cut to the correct size and shape to form crown 18 with slot 28. A compression machine presses the titanium material against the mold at a pressure of about 300,000 kg/m^2 to forge crown 18 with slot 28. The process is referred to as "slotting." Face 16 is preferably forged from HT-treated β-2041 titanium alloy, and sole 30 is preferably forged from CT-2 titanium alloy. Sole 30 and face 16 are then welded together.

Next, the loft angle is adjusted to the design requirement, and a hosel is attached to crown 18. The lie angle is adjusted to meet the design requirements, and crown 18 is welded to sole 30 and face 16. The welding of club head 14 is examined along with its overall shape.

Club head 14 is heat treated, and the hardness of club head 14 is checked using the Rockwell Scale to confirm that the hardness meets design requirements. In addition, the geometry of club head 14 is checked for any changes that may have occurred during heat treatment.

Club head 14 is polished to provide the desired finish (such as satin or mirror). The geometry of club head 14 is rechecked for any changes that may have occurred due to polishing.

A cannon test is used to test the strength of club head 14. Then, an epoxy is injected into club head 14 so that any loose, tiny particles resulting from welding are prevented from making any noise when a golf ball is hit.

Slotting along rear portion 20 of crown 18 substantially improves structural integrity. The stabilizing effect of slotting improves club performance in three ways. First, it provides back-weighting toward rear portion 20 and sole 30. The extra weight adjusts the center of gravity to produce the most desirable ball flight.

Second, as described above, slotting stiffens crown 18 of club head 14. This results in a substantial reduction in club head deformation (the momentary increase in driver height resulting from the impact of the ball upon face 16). Slotting dampens the energy-robbing effect of deformation and results in longer, straighter drives.

Third, in initial tests of golf club 10, players report a pleasant, solid sensation at impact.

A fourth benefit of slotting is the improved aerodynamics. Slot 28 produces a tunneling effect that redirects air flow during the golf swing resulting in

smoother air contact against club head 14. Swing speed, depending on the individual, is enhanced from one to three miles per hour (mph). Extra swing speed, all factors remaining equal, translates into an extra 2.25 yards per mph.

Lastly, slotting is aesthetically pleasing, because the curved surface can be finished to match sole 30 which highlights slot 28.

Figure 4 is a cross section of the golf club head. Club head 14 includes crown 18 with rear portion 20, top portion 26, outer surface 32, and inner surface 34; and sole 30. Rear portion 20 of crown 18 further includes upper convex portion 36 with corresponding upper concave portion 38, lower convex portion 40 with corresponding lower concave portion 42, middle concave portion 44 with corresponding middle convex portion 46, and curvature line 48.

Upper convex portion 36 is on outer surface 32 of crown 18. Upper concave portion 38 is on the corresponding inner surface 34 of crown 18. Lower convex portion 40 is on outer surface 32 with lower concave portion 42 corresponding on inner surface 34. Middle concave portion 44 is on outer surface 32 with middle convex portion 46 corresponding on inner surface 34.

Curvature line 48 extends as an arch between upper convex portion 36 to lower convex portion 40. Curvature line 48 represents the profile of rear portion 20 without slot 28. As can be seen, the curvature of upper convex portion 36 and lower convex portion 40 is identical to corresponding regions of crown 18 without slot 28.

Figure 5 is a back view of driver 10 showing a first embodiment of adding weights around slot 28. Driver 10 includes shaft 12 and club head 14. Club head 14 includes crown 18 with rear portion 20, top portion 26, slot 28, and weight 50; and sole 30. Rear portion 20 further includes upper convex portion 36, lower convex portion 40, and middle concave portion 44. Weight 50 is actually added to inner surface 34 of club head 14 by soldering pieces of metal into crown 18 before

assembling all the parts for club head 14. Weight 50 can be any type of metal, and preferably is cheap, scrap metal.

Weight 50 is shown in the dark shaded region at rear portion 20. For ease of illustration, weight 50 is described in Figures 5-7 with reference to portions of slot 28 on outer surface 32 of crown 18. However, weight 50 is actually added to the corresponding portions on inner surface 34 as described in Figure 4. Adding weight 50 equally between upper convex portion 36 and lower convex portion 40 stabilizes club head 14 at impact, which results in a slightly higher launch angle and longer carry.

Figure 6 is the same view of driver 10 with identical reference numbers as Figure 5. Weight 50, however, is placed at upper convex portion 36. Adding weight 50 at upper convex portion 36 raises the center of gravity resulting in a lower launch angle. This embodiment is suited for better players.

Figure 7, again, is the same view of driver 10 with identical reference numbers as Figure 5. Here, weight 50 is at lower convex portion 40. Adding weight 50 at lower convex portion 40 lowers the center of gravity, which results in a higher launch angle. This embodiment is best suited for beginning, women, and youth golfers.

Although the present invention has been described with reference to preferred embodiments, workers skilled in the art will recognize that changes may be made in form and detail without departing from the spirit and scope of the invention.